German Patent No. 39 34 654 A1

Job No.: 310-104872 Ref.: OTS029435
Translated from German by the McElroy Translation Company
800-531-9977 customerservice@mcelroytranslation.com

FEDERAL REPUBLIC OF GERMANY
GERMAN PATENT OFFICE
PATENT NO. 39 34 654 A1

Int. Cl.^{5}:	G 01 M 13/02 B 65 G 43/02 //G 01 N 27/00
Filing No.:	P 39 34 654.4
Filing Date:	October 14, 1989
Disclosure Date:	May 23, 1991

BREAK-TESTABLE OPEN-ENDED CARRIER BELT AND METHOD OF BREAK TESTING OPEN-ENDED CARRIER BELT

Inventor:	Peter Suhling 2803 Weyhe, DE
Applicant:	Sondermaschinenbau Peter Suhling GmbH 2800 Bremen, DE
Agents:	R. Münzhuber 8000 Munich A. Boehmert Dr. W. Hoormann 2800 Bremen Dr. H. Goddar Dr. R. Liesegang E. Eitner 8000 Munich Dr. A. Winkler Patent Attorney W. Stahlberg W. Kuntze Dr. L. Kouker Attorney-at-Law 2800 Bremen

Examination request filed according to § 44 of the Patent Act

In an open-ended carrier belt, consisting of several essentially parallel strands of an electrically conducting material that take up strain forces and a belt body enclosing the carrier strands, the invention proposes continuously break testing the carrier strands while the carrier belt is under load by designing at least one carrier strand on the two ends (5a, 5b) of the belt body, so that an electrically conducting connection site is formed. At this connection site, a test voltage is applied and the resulting test current recorded. A break in the strand interrupts the test current, which can trigger a signal, etc.

A particularly advantageous embodiment of the invention consists of the fact that the carrier strands (12a-12h) are electrically connected in pairs to each other on the two ends (5a, 5b) of the carrier belt (5), so that they are connected in series and together form a single electrical conductor that can be continuously tested for current-carrying capability.

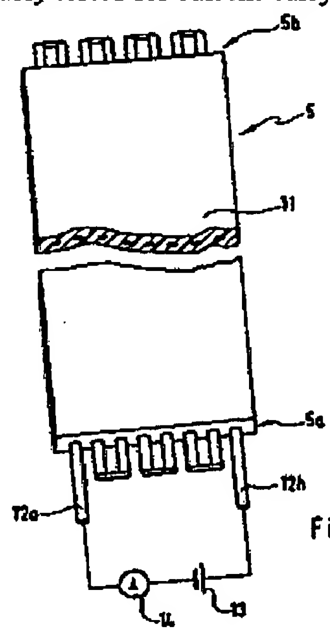

Fig. 3

The invention concerns an open-ended carrier belt with the features of the preamble of Claim 1, as well as a method for testing under load an open-ended carrier belt with the features of the preamble of Claim 5.

In numerous conveyors, hoisting devices, handling machines, etc., open-ended carrier belts, for example, in the form of flat or toothed belts, are used as machine elements that transfer stress. The carrier belts used in many of these machines are safety-critical components, since their failure, in the form of a rupture or tear, could lead to falling of valuable freight or to a hazard to operating personnel.

Ordinary open-ended carrier belts in the form of flat or toothed belts ordinarily consist of several essentially parallel-arranged strands that take up the strain forces, which are enclosed by a belt body, usually consisting of plastic. Sometimes the mentioned commercial flat or toothed belts are also provided with a plastic fabric, etc., in order to limit wear. The belt body itself, in the form of a plastic shell, serves only for shaping, in the case of a toothed belt, especially forming of the individual teeth. The longitudinal force to be transferred by the carrier belt is fully taken up by the strands embedded in the carrier belt.

Especially in carrier belts that are arranged within a hoisting mechanism, so that they are guided over a deflection roll, after longer operating time and because of the many contortions connected with it, it can happen that one strand after another will break. Generally, one of the two exterior sides of the carrier belt is exposed to a higher load, for which reason the strand arranged next to this edge ruptures first. The next strands adjacent to the belt center must then together take up the total longitudinal force of the ruptured strand, which leads to premature rupture of additional strands. Successive tearing or rupture of the individual strands therefore occurs, until the entire belt is torn.

Complete tearing of a carrier belt and the falling of the load connected with it must absolutely be avoided for the reasons already explained. Since, however, a ruptured strand cannot be directly recognized as such even in carrier belts, whose outer belt body consists of a translucent plastic, carrier belts that are critical for safety reasons are either overdimensioned or are replaced early. Both solutions are unsatisfactory, especially because of the higher costs connected with them.

It is known to arrange conducting loops in the belt body of revolving endless conveyor belts and to use them to indicate penetration of foreign bodies into the moving belt, or to switch-off the drive motor by triggering a signal, in order to avoid the splitting that is especially feared for conveyor belts with wire or cable inserts running only in the longitudinal direction. It is also known from DE-PS 17 56 660 to lay out the conductor loops inserted into the conveyor belts so that an inadmissible elongation of the conveyor belt is recognized in timely fashion.

A proposal is known from DE-AS 19 40 945 to refit conveyor belts already in use with electrical conductor loops, which are embedded in prefabricated molded pieces of vulcanized rubber or cured plastic material adapted in size and shape. The conductor loops are inserted into a correspondingly worn or cutout part of the cover or running layer of the corresponding conveyor belt and bonded to the conveyor belt during cold vulcanization or gluing.

In both cited sources, endless conveyor belts are described that are subsequently equipped with additional conductor loops that serve exclusively as signal indicators. These conductor loops therefore do not have a support function. The current-carrying capability of the

additional conductor loops is then preferably tested inductively or capacitively by fixed scanning elements, since a resistive coupling is problematic, because of the revolving conveyor belt.

In the methods known from the prior art, additional components are required, which are subsequently applied to the conveyor belts. On the one hand, this is connected with additional costs, and, on the other, it is not possible to apply additional conductor loops in numerous commercial carrier belts for reasons of design height, etc. Moreover, the known methods have the drawback that the integrity of the carrier elements is only indirectly tested. It is extremely difficult to lay out the arrangement and dimensioning of the additional conductor loops, so that a rupture of a carrier strand is reliably recognized. In a conceivable, unfortunate coincidence of different tolerances, it may occur that although a carrier strand is already ruptured, the electrical values of the additional conductor groups serving as indicators will be still unchanged. Breaks are therefore not always reliably recognized.

The underlying problem of the invention is to modify an open-ended, preferably commercial, carrier belt, so that during operation, continuous reliable break testing of individual or all carrier strands is made possible. Another problem of the invention is to provide a method for testing an open-ended carrier belt for rupture of individual carrier strands during operation.

The solution to the problem, in a generic open-ended carrier belt of the type described in the introduction, consists, according to the invention, of designing at least one of the carrier strands on both ends of the support frame relative to the belt body, so that an electrically conducting connection site is produced.

A particularly advantageous embodiment of the invention consists of electrically connecting the carrier strands on the two ends of the carrier belt in pairs, so that they are connected in series and overall form a single electrical conductor. With respect to the method portion of the problem, the solution according to the invention is provided by the features of the characterizing portion of Claim 5.

The particular advantage of the invention is seen in the fact that commercial flat or toothed belts can be used, which need only be prepared accordingly. In this manner, an extremely cost-effective possibility is created for testing open-ended carrier belts continuously and, above all, reliably for breaks.

It is also possible to retrofit already available hoisting machines in extremely simple fashion for continuous break testing of the toothed or flat belt. For this purpose, only the toothed belts being incorporated must be laid out slightly longer than was previously the case and "stripped of insulation" at the two ends. Joining of the carrier strands in pairs can then occur, whereupon a test voltage is applied.

The invention is further explained below with reference to the drawing. In the drawing

Figure 1 shows a schematic view of a linear hoisting machine equipped with a flat belt according to the invention,

Figure 2 shows a cross section through a flat belt according to the invention and

Figure 3 shows a perspective view of a commercial flat belt, prepared according to the invention.

The linear hoisting machine, depicted schematically in Figure 1, consists essentially of a hydraulic cylinder 2 with a piston rod 3, which carries a deflection roll 4. An open-ended flat belt 5 runs on the deflection roll 4, which is firmly clamped on one end 5a between two clamping jaws 6 and 7. On its other end 5b, the flat belt is firmly connected to a slide 8, which can be moved up and down along a guide rail 9. Slide 8 is moved together with a load 10 lying on it, in which the piston rod 3 and the deflection roll 4 with it are moved by corresponding pressure activation of hydraulic cylinder 2. The slide 8 then moves in the vertical direction by twice the path as the piston rod 3.

The flat belt 5 is exposed primarily to tension due to the weight force of load 10 and slide 8. The tensile forces to be taken up by the flat belt in hoisting machines, which are operated at high speed, for example, in manufacturing lines, etc., can amount to a multiple of the weight of slide 8 with load 10. In the region of the flat belt 5 lying against the deflection roll 4, it is also exposed to bending. Since, during movement of the hoisting machine, a different region of the flat belt comes to lie against the deflection roll, an alternating load is involved in the bending load. As a result of alignment errors, etc. and the slightly asymmetric load resulting from it, one of the outer-lying strands is often particularly affected by this alternating load, i.e., by an alternation of compressive and tensile stresses in the individual strands.

A flat belt is shown in cross section in Figure 2. Eight strands 12a to 12h, consisting of wire, are embedded in a belt body 11, consisting of plastic in the present embodiment. If a rupture of one of the outer-lying strands 12a or 12h occurs as a result of numerous contortions of the flat belt, the strands 12b or 12g will next be threatened. If these ruptures are not recognized in timely fashion, successive rupture of the individual strands occurs (as in a row of dominos falling, one after the other), until the tensile forces can no longer be supported and the load 10 falls. When load 10 falls, an accident can occur, and the load 10 will probably be damaged or damage other parts by its fall.

In order to recognize a rupture of a strand in timely fashion and replace the flat or toothed belt in time, a commercial flat or toothed belt is prepared, as shown in perspective in Figure 3. In the region of ends 5a and 5b of flat belt 5, the belt body 11 is stripped of insulation, so that the carrier wire strands 12a to 12h are exposed. On the end 5b, beginning from the edge, two wire strands are electrically connected pair-wise. Electrical connection of two strands can occur in different ways. Soldering of the two strands, clamping with a cable shoe, etc. are conceivable.

On the other end 5a of the flat belt, the middle six strands are connected in pairs, so that a series circuit of the individual strands is produced, which, overall, forms a single electrical conductor. The protruding ends of the outer-lying strands 12a and 12h on the end 5a of the flat belt stripped of insulation then form the end piece of this conductor. The end pieces are connected to a test voltage source 13 and an ammeter 14 connected to it. A current is driven through the belt body, consisting of the individual strands, by the test voltage source 13, which is displayed by the ammeter 14.

If a strand breaks, the test current is simultaneously interrupted, which is indicated by the ammeter 14. If a break or tear of the entire belt occurs, it can be replaced and subsequent damage thereby avoided.

It is immediately obvious to one with average skill in the art that the ammeter is the worst of all possible monitoring devices and was chosen only for schematic depiction of the principle according to the invention. Instead of an ammeter, an electronic circuit can naturally be incorporated, which triggers an acoustic signal during interruption of the test current, automatically shuts off operation of the hoisting machine, etc. In this case, only a brief interruption of the test current can also be recognized, as occurs, for example, if a strand was already broken but the ruptured ends still touch each other occasionally. Within the electronic circuit, the series connection of the individual strands can, in turn, be connected in series to the base resistor of a common-emitter connected transistor. A variety of other switching stages can be driven from this common-emitter circuit.

As is apparent from Figure 3, in an open-ended carrier belt that was prepared according to the invention, there is one end to which the test voltage source must be connected. In a flat belt, which is arranged on the linear hoisting machine, as shown in Figure 1, so that the one end is moved, while the other end 5a is fixed, connection of the voltage source is preferably provided on the latter end.

List of reference numbers

1	Hoisting machine
2	Hydraulic cylinder
3	Piston rod
4	Deflection roll
5	Flat belt
5a	End of 5
5b	End of 5
6	Clamping jaw
7	Clamping jaw

8	Slide
9	Guide rail
10	Load
11	Belt body
12a-12h	Strands
13	Voltage source
14	Ammeter

Claims

1. Open-ended carrier belt, consisting of several essentially parallel-arranged strands of an electrically conducting material that take up strain forces, and a belt body surrounding the carrier strands, consisting of an electrically non-conducting material, characterized by the fact that at least one of the carrier strands (12 – 12h) on the two ends (5a, 5b) of the carrier belt (5) are designed relative to the belt body (11), so that an electrically conducting connection site is formed.

2. [Open-ended] carrier belt according to Claim 1, [characterized by the fact] that on both ends (5a, 5b) of the carrier belt (5), the carrier strands (12a – 12h) are electrically connected in pairs, so that they are connected in series and form overall a single electrical conductor.

3. Open-ended carrier belt according to Claim 1 or 2, characterized by the fact that the carrier belt (5) consists essentially of a known commercial flat belt that is further processed, in which the strands (12a – 12h) are exposed by removal of the belt body (11) and are optionally connected in pairs.

4. Open-ended carrier belt according to Claim 1 or 2, characterized by the fact that the carrier belt (5) consists essentially of a known commercial toothed belt, which is further processed by exposing the strands (12a – 12h) by removal of the belt body (11) and are optionally connected in pairs.

5. Method for testing of an open-ended carrier belt under load with the features of the preamble of Claim 1 for rupture of at least one strand, characterized by the fact that at least one of the strands (12a – 12h) on the two ends (5a, 5b) of the carrier belt (5) is exposed by removal of the belt body (11), that a test voltage is applied to the two exposed ends of the strand, that the electric current produced by the test voltage through the strand is recorded by a corresponding circuit, and any interruption of this current is recorded by appropriate means.

6. Method for testing of an open-ended carrier belt under load with the features of the preamble of Claim 1 for rupture of at least one strand, characterized by the fact that the strands (12a – 12h) are exposed on the two ends (5a, 5b) of the carrier belt (5) by removal of the belt body (11), that the carrier strands (12a – 12h) are electrically connected in pairs, so that they are

connected in series and, overall, form a single electrical conductor, that a test voltage is applied to the two ends (12a, 12h) of the produced electrical conductor, that the electric current generated by the test voltage in the conductor is recorded by a corresponding circuit, and that any interruption of this current is recorded by appropriate means.

7. Method according to Claim 6, characterized by the fact that the circuit switches off a machine in which the carrier belt being tested is incorporated as a machine element during interruption of the current.

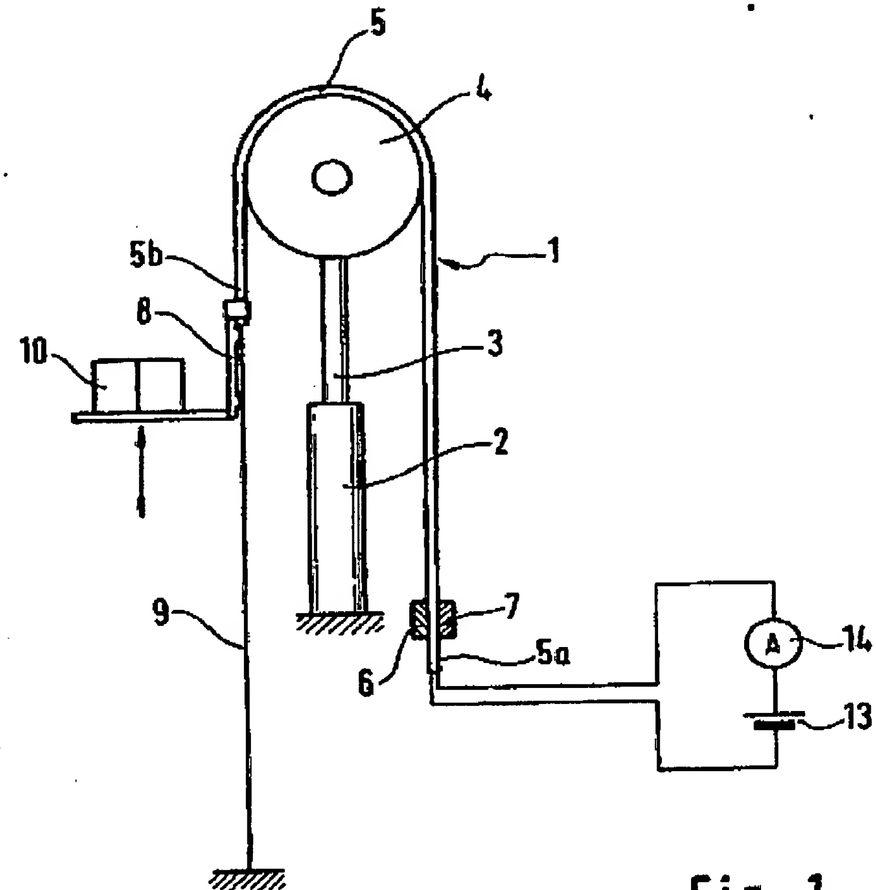

Fig. 1

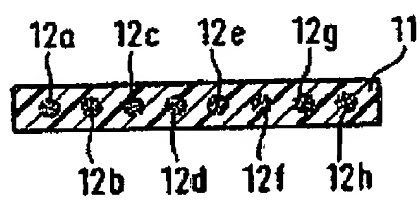

Fig. 2

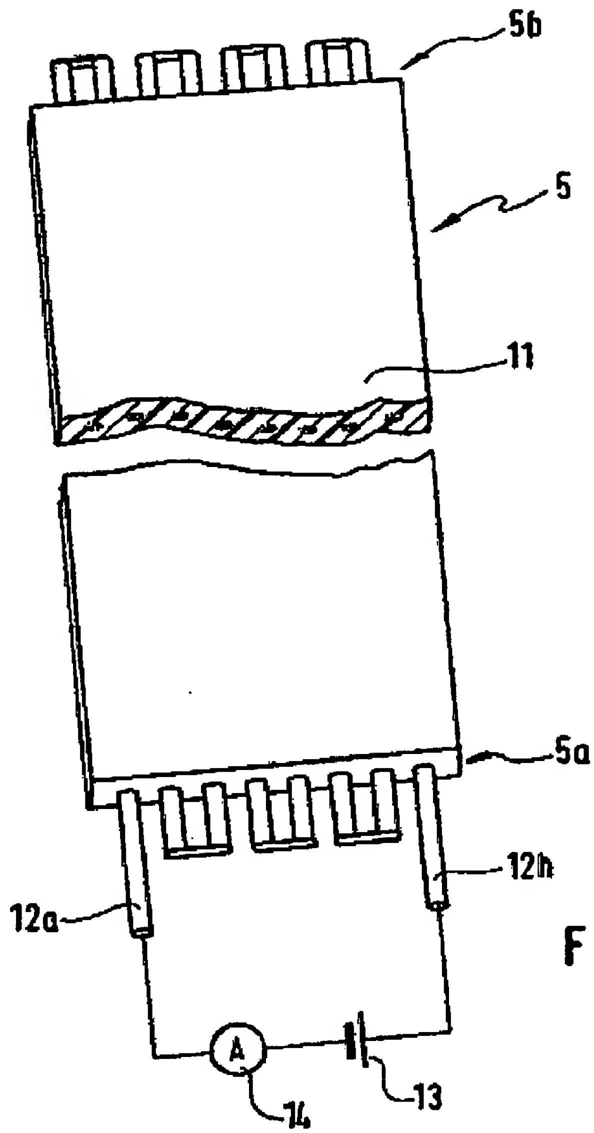

Fig. 3